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USING HELICOPTER TO CHEMICALLY CONTROL BIG SAGEBRUSH AND WYETHIA ON THE BEAVERHEAD NATIONAL FOREST, 1959

METHODS AND PRELIMINARY RESULTS

U.S. Department of Agriculture
Forest Service - Region 1
Missoula, Montana

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Date: January 26, 1960 (Revised 1/15/61)

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USING HELICOPTER TO CHEMICALLY CONTROL BIG SAGEBRUSH AND WYETHIA ON THE BEAVERHEAD NATIONAL FOREST, 1959

I. SUMMARY APPRAISAL

Flight-height restrictions forced Region 1 to discontinue use of fixed-wing aircraft for control of undesirable range plants. Helicopter use was initiated as an alternative.

Sagebrush and wyethia occupy extensive areas on the Beaverhead National Forest. Much of this area will benefit from the control of these undesirable range plants. To interest helicopter bidders several projects were grouped totaling some 11,000 acres.

A helicopter project of this size was new to the region. Very limited information was available on crew organization, equipment rental, how and where to locate helispots, and other factors influencing the feasibility of such a project. On this project, enough records were kept to analyze costs and accomplishment data which will be useful in planning future projects.

Accomplishments were greater than anticipated. National forest area treated was 10,770 acres. Performance of the G-2 Bell helicopter was greater than expected; 20 to 40 gallons of spray material per trip were hauled and sprayed on areas ranging in elevation from 6,400 to 8,500 feet. Spray material was applied uniformly and in the safest manner known.

Per acre flying costs competed closely with previous costs for fixed-wing. Spray flight time was bid at $105 per hour. Flying time for hauling personnel was at the regional fire contract rate of $90 per hour. Flying costs averaged $1.06 per acre, including all ferry time to haul flaggers and others to spray areas. Total costs including some protection fencing averaged $5.01 per acre.

Sample card checks showed a high rate of material reached the ground vegetation. Sagebrush kill approaches 100 percent - wyethia 87 percent on four remeasured 3-step clusters. Varying weather conditions seemingly had little affect on sagebrush kill.

Three study plots were established, using different intensities of acids and application rates to see if less material would give satisfactory results. One pound of acid equivalent in oil carrier applied at the rate of 2 gallons per acre gave 88 percent kill of sagebrush on test plot. Using 1-1/3 pounds and 2 pounds, respectively, at the same rate of application gave 75 percent kill. Since 2 pounds of acid equivalent applied at 3 gallons per acre secured almost complete kill, the writers are unable to fully explain reason for the above test results. We feel, however, that satisfactory kill of sagebrush can be achieved using 1-1/2 pounds of acid equivalent mixed in diesel oil carrier and applied at 2 gallons per acre.

Forage production measured on three areas by clipping and weighing twenty .96 square-foot plots showed average increase of 885 pounds of grass per acre air dried, while forbs decreased 670 pounds per acre.

Abundant grass seedlings, improved vigor, and decrease of undesirables, all indicate upward trend in vegetation. Grazing protection for 1 or 2 years is very essential on the areas treated to allow the desirable seedlings to establish themselves in bare spaces.

Coordination required for big game was not fully achieved. Some 12 miles of willow stream bottom, important as moose habitat, was damaged from spray drift. Some willow recovery through resprouting is occurring.

The project was completed with dispatch, and the results very favorable. Close cooperation existed between the contract fliers and the ground-crew organization. The Johnson Flying Service is commended for their excellent service and the Beaverhead National Forest for the manner in which the project was organized, supervised, and carried to successful completion. Similar projects in the future should be favorably considered by the region.

II. ADAPTABILITY

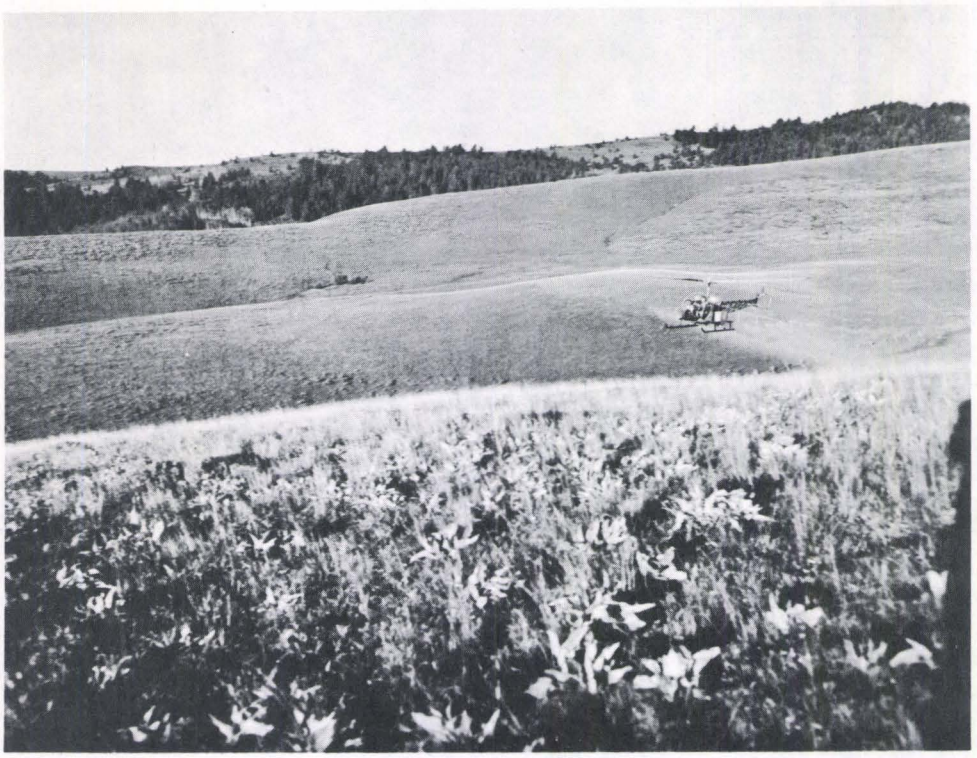
The region initiated aerial control of undesirable range plants in 1955, using fixed-wing aircraft. A serious mishap occurred in 1957, causing the adoption of 100 feet minimum flight height for fixed-wing planes. In 1958, a pilot study was made using fixed-wing spraying at 100, 200, and 300 feet elevations with very unsatisfactory results. After considerable investigation of helicopter use, elsewhere, its use was initiated as a means of continuing the chemical spray program to control undesirable range plants.

Safety was given full consideration on all phases of the project. The job was completed without a mishap. One of the key safety factors to a safe project is to have an adequate windsock or flag at each helispot. Landing a helicopter with a tailwind can be disastrous. Copy of the safety plan is included in the appendix.

III. LOCATION, TIME, AND AREA

The helicopter spraying was done on the Beaverhead National Forest between June 15 and July 12, 1959. It was timed to spray when sagebrush was growing vigorously and wyethia was in early bloom stage. Areas treated are located on the south end of the Gravelly Range and on the Pioneer Range in the Big Hole. The Gravelly Range topography is broken by many small drainages with moderately steep slopes and rounded ridgetops. The Big Hole area is less broken and has more gentle slopes. Elevations of spray areas range from 6,400 feet to 8,500 feet. Annual precipitation varies from 12 inches in the Big Hole to 20 inches on the Gravelly Range. Soil is sandy loam in the Big Hole and clay loam in the Gravellies. This spraying was done on sheep and cattle ranges.

Heavy stands of big sagebrush (Artemesia tridentata) and mules-ears wyethia (Wyethia amplexicaulis) were treated. Sagebrush areas had a fair to good understory of desirable range grasses. Most wyethia areas had sparse cover of desirable range plants.



Spraying interspersed stands of big sagebrush and wyethia - Gravelly Range.

The total area treated on the national forest was 10,770 acres. Projects were: the West Fork, 6,400 acres, and Landon, 2,410 acres - Madison Ranger District; Doolittle, 970 acres - Wisdom Ranger District; and Bull Creek, 990 acres - Jackson Ranger District. In addition, 320 acres were sprayed for the Bureau of Land Management under cooperative deposit agreement.

IV. MANPOWER ORGANIZATION

The manpower used was greater than is considered necessary for future projects. Essential manpower was hired to secure desired costs and time records for use in planning future projects. Helicopter contracting was on an hourly basis, since the region and prospective contractors lacked information on what the per-acre flying costs might be. Contracting by the hour required keeping additional time records. Five flaggers were used on flight lines of 1 mile or more in length. Three flaggers were adequate for flight lines up to 1 mile. The contractor

furnished two pilots and one mechanic, plus transportation for these personnel, and for gasoline to the helispots. The pilots alternated so each had 1 hour's flying time and 1 hour's rest. Due to the strenuous nature of the flying, the use of two pilots was considered a good safety precaution. (See appendix B for organization chart.)

V. EQUIPMENT AND USE

A. Aerial

A G-2 Bell helicopter was used. It was equipped with two connecting tanks with total capacity of 120 gallons. The spray boom was 29 feet 2 inches long and made of 1/2-inch aircraft tubing. Nineteen number 2 spray system incorporate nozzles were used with orifices of 3/32 inch. These were pointed 90 degrees downward. The spray pressure maintained was 45 to 47 pounds. Flying speed was 45 miles per hour and flight height from 15 to 25 feet. Effective spray width was 50 feet.

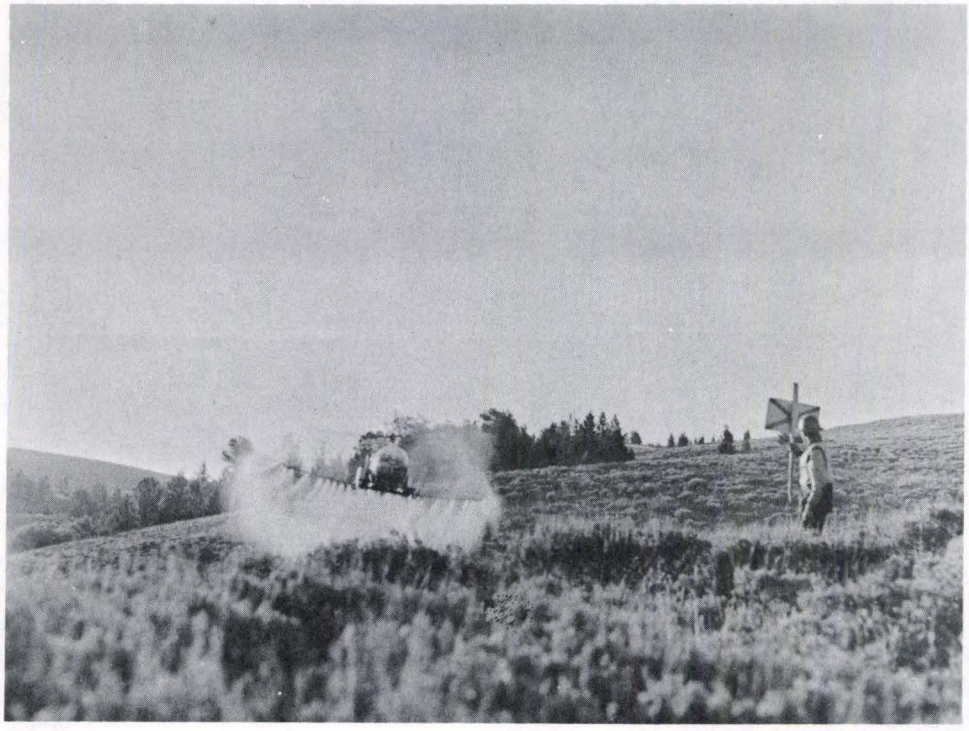
The Bell G-2 helicopter and spraying equipment. Using milk can to load helicopter.

The proper location of helispots in relation to the area to be sprayed is a key factor to a successful operation. Helispots need to be so located that ferry time back for reloading is held to a minimum. Our experience pointed toward having helispots located not more than 1 mile apart. One day spray mix was available at two adjacent helispots

approximately 1-1/4 miles apart. When the helicopter needed a new load of mix the pilot would return to the nearest helispot. A certain amount of empty ferry time was saved, but in order to make such a plan work, it is necessary to have loaders available at both helispots along with the necessary storage of spray mix. The increased loading cost may or may not result in a savings in helicopter hire. At the rate of $1.75 per minute for helicopter hire, it is important to devise the best possible use of every second.

Suitable helispots could be found with a minimum of clearing needed to eliminate brush that would catch spray boom and its supports. Open ridgetops with sharp breakaway are most desirable locations.

Suitable flying time each day and period for treating wyethia is generally limited. Our desire was to spray as many acres as possible and at the proper time. In order to do this, the helicopter was applying spray mix to the maximum flying time each day and moved to different areas as wyethia plant development reached the early blooming stage. Temperature was usually the limiting factor on length of flying for each day.



Applying 2,4-D chemical to big sagebrush.

Applying 2,4-D chemical to big sagebrush.

B. Automotive and Other

Automotive equipment used:

1 power wagon, 1-ton, International, with 500-gallon tank (maximum load hauled 400 gallons).
1 jeep, 1-ton, 4-wheel drive, with 300-gallon tank (200 gallon maximum load hauled).
1 tanker, semi-, 4,000-gallon. Used as mother tank.
2 pickups, 1/2-ton, 4-speed.
2 pickups, 1/2-ton, 4-wheel-drive.
1 pickup, 3/4-ton, 4-speed.

Spray mix was hauled to the mother storage tanker by two oil companies holding Government fuel oil contracts. These companies mixed the 2, 4-D chemical with the fuel oil with no additional cost for this service. Close supervision and assistance were given by forest officers.

The major difficulty and chief concern experienced was making certain an adequate supply of spray mix would be available for immediate loading at the particular helispot from which the helicopter desired to operate.

Our 4-wheel-drive tanker trucks required 2 hours, on the average, to make a round trip from the mother storage tanker to the helispots, although it varied from 1 hour to as long as 3 hours. Therefore, unless these tanker trucks were emptied immediately upon arrival at the helispot, we would fail to keep a supply of spray mix moving from the mother storage tanker to the helispots.

The lack of suitable roads for hauling spray mix to helispots was a problem. When motorized equipment bogged down in the mud, two strings of pack mules were moved in to haul spray mix to the helispots. Some spray mix was hauled with these mules, but they did not prove to be the answer to the problem.

Storage at the helispots was provided by using both extra 10-gallon milk cans and 55-gallon drums. When a tank load of spray mix arrived at the helispot, all empty milk cans were filled by gravity flow. Any mix remaining was put into 55-gallon drums. We attempted to avoid the use of 55-gallon drums since mix stored in them had to be pumped out by hand into the milk cans for dumping into the helicopter. However, in order to have plenty of mix ahead at the helispots, we found it necessary to use these 55-gallon drums.

Storage at helispot.

There are several possible ways to overcome this problem of supply:

1. Provide additional 4-wheel-drive tanker trucks with pumper attachment to have ample spray mix storage at the helispots and also have ample spray mix hauling capacity.

2. Provide larger capacity 4-wheel-drive pumper tanker trucks.

3. Provide an adequate combination of 1 and 2 above.

4. Provide suitable trailer-type power tankers so as to have the mix at helispots well in advance of need.

These trailer tankers can be moved with crawler-type tractors to helispot locations in difficult situations.

VI. CHEMICAL AND APPLICATION RATES

The chemical used was a low volatile 2,4-D. Both 4- and 6-pound acid equivalent concentrates were used. The 4 pound was mixed in oil at a ratio of 1 gallon 2,4-D chemical to 5 gallons of diesel oil. The 6 pound concentrate at the ratio of 1 to 8.

The planned treatment was to apply 3 gallons of spray mixture per acre. However, the average overall application was only 2.8 gallons per acre.

VII. SUMMARY ANALYSIS OF COST AND ACCOMPLISHMENT

Value of chemical on hand (fiscal year 1957)	$9,331.05
1959 fiscal year budget and expenditure	33,894.84
1960 fiscal year expenditure	14,436.13
Total available	$57,662.02
Less: Expenditure Metzel Creek fixed-wing flight-height study	2,760.76
Value of chemical on hand	965.00
	3,725.76
Total expenditure on helicopter project	$53,936.26

National forest acreage treated by projects:

West Fork	6,400 acres
Landon	2,410 acres
Doolittle	970 acres
Bull Creek	990 acres
	10,770 acres

Average cost per acre, including fencing, $5.01.

The high elevation, long distances from supply centers, and poor accessibility to helispots are three important factors affecting accomplishment and overall project costs.

VIII. SUMMARY OF DAILY ACCOMPLISHMENT

1959	Number loads		Gallons sprayed		Acreage sprayed		Flight time				Accumulated total
							Spraying		Ferrying		
	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	
6-15	16	16	440	440	*120	120	1:48	1:48	0:36	0:36	2:24
6-16	36	52	1,015	1,455	**360	480	4:03	5:51	-	0:36	6:27
6-17	45	97	1,270	2,725	580	1,060	4:07	9:58	0:30	1:06	11:04
6-18	54	151	1,540	4,265	590	1,650	5:34	15:32	0:06	1:12	16:44
6-19	63	214	1,830	6,095	660	2,310	6:02	21:34	0:09	1:21	22:55
6-20	53	267	1,410	7,505	590	2,900	5:02	26:36	0:17	1:38	28:14
6-21	-	-	(Rained all day)		-	-	-	-	-	-	-
6-22	23	290	660	8,165	260	3,160	2:20	28:56	0:20	1:58	30:54
6-23	43	333	1,230	9,395	440	3,600	3:41	32:37	0:21	2:19	34:56
6-24	64	397	1,830	11,225	640	4,240	5:16	37:53	0:45	3:04	40:57
6-25	75	472	2,130	13,355	720	4,960	7:35	45:28	0:36	3:40	49:08
6-26	-	-	(Rained all day)		-	-	-	-	-	-	-
6-27	101	573	3,000	16,355	1,060	6,020	8:27	53:55	0:07	3:47	57:42
6-28	33	606	930	17,285	355	6,375	3:06	57:01	0:04	3:51	60:52
6-29	44	650	1,280	18,565	440	6,815	4:34	61:35	0:38	4:29	66:04
6-30	22	672	660	19,225	240	7,055	2:17	63:52	0:12	4:41	68:33
7-1	55	727	1,530	20,755	520	7,575	5:10	69:02	0:37	5:18	74:20
7-2	42	769	1,320	22,075	450	8,025	4:51	73:53	0:04	5:22	79:15
7-3	3	772	50	22,125	17	8,042	0:17	74:10	0:17	5:39	79:49
7-4	44	816	1,185	23,310	405	8,447	4:24	78:34	-	5:39	84:13
7-5	48	864	1,295	24,605	440	8,887	4:43	83:17	0:10	5:49	89:06
7-6	21	885	630	25,235	240	9,127	2:43	86:00	-	5:49	91:49
7-7	-	-	(Moved from West Fork to Wisdom)				-	-	-	-	-
7-8	62	947	1,840	27,075	614	9,741	6:15	92:15	2:33	8:22	100:37
7-9	35	982	1,075	28,150	359	10,100	3:58	96:13	-	8:22	104:35
7-10	39	1,021	1,140	29,290	380	10,480	3:47	100:00	1:17	9:39	109:39
7-11	36	1,057	1,080	30,370	360	10,840	3:38	103:38	0:05	9:44	113:22
7-12	36	1,093	750	31,120	250	11,090	3:07	106:45	0:05	9:49	116:34

*Spraying for BLM.
**200 acres for BLM.

Average number gallons per day 1,245
Average number acres per day 444
Average spray time per day 4:27
Average ferry time per day 0:24

Average loads per day 44
Average number gallons per load 28.5
Average number gallons per acre 2.81

IX. BENCH MARKS

A. Check Plots

Three 70-acre test plots were sprayed, using the following 2, 4-D acid intensities and fuel-oil carrier:

Test plot 1 - 1 pound acid equivalent in 2 gallons of oil.
Test plot 2 - 1-1/3 pounds of acid equivalent in 2 gallons of oil.
Test plot 3 - 2 pounds of acid equivalent in 2 gallons of oil.

A strip 100 feet wide was left unsprayed between the plots so effects of drift would be eliminated.

General view of check plot area.

Evaluation of kill on the three check plots was made on June 30, 1960. Two hundred plants in each block were checked at pace intervals on a random selected line. The nearest plant to pace interval was examined and recorded as being alive or dead. Plants were considered living if any green leaves were seen. Most of the living plants recorded had more than 75 percent of the crown area killed and many 90-95 percent.

The tabulated test plot results are as follows:

Test plot 1 - 2 pounds acid at 2 gallon rate.

Dead - 151	Percent dead - 75
Live - 49	Percent live - 25

Test plot 2 - 1-1/3 pounds acid at 2 gallon rate.

Dead - 149	Percent dead - 75
Live - 51	Percent live - 25

Test plot 3 - 1 pound acid at 2 gallon rate.

Dead - 176	Percent dead - 88
Live - 24	Percent live - 12

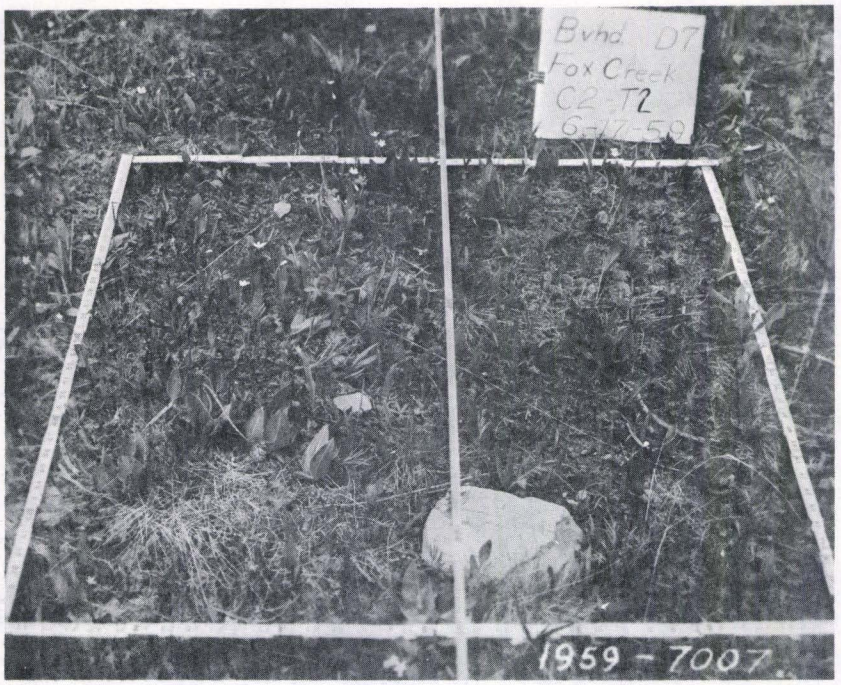
The writers are unable to fully explain the reason for the best results on the plot with lowest amount of acid equivalent being used. Since kill on the main project approaches 100 percent using 2 pounds acid applied at 3 gallons per acre further complicates the evaluation of the test plots. Some of the difference can be logically attributed to the check plots not being large enough to be an adequate sample.

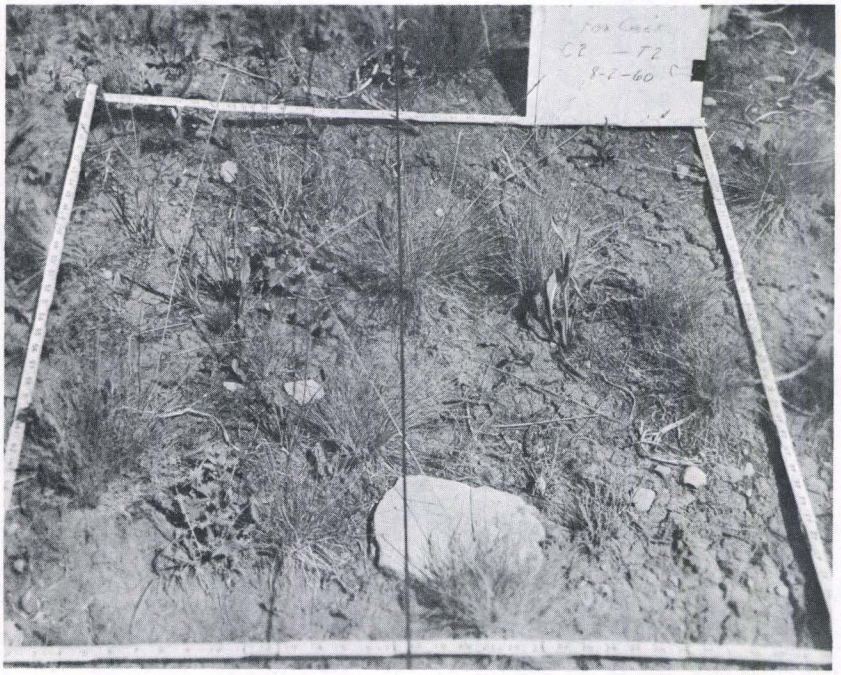
B. Three-Step Clusters

Four 3-step clusters were established in representative areas of sagebrush and wyethia on the West Fork and Landon projects. Clusters were also established on representative sagebrush areas on the Doolittle and Bull Creek spray projects. The following eight photos are before and after pictures on two 3-step clusters on the West Fork project.

General View

Closeup View





General View

Closeup View

Tabulated below is partial breakdown of species hits recorded on 3-step clusters established in 1959 and reread in 1960.

Cluster	Transect	Year	Feid	Wyethia	Sage (Artr and Arca)	Total grasses	Total forbs	Total shrubs	Total plant hits	Remarks
C2	T1	1959	3	7	0	13	21	0	34	
		1960	4	0	0	18	3	0	21	Abundant melica seedlings
	T2	1959	2	7½	0	4½	29½	0	34	
		1960	2	2	0	8	6	0	14	Many grass seedlings
	T3	1959	3	5	0	19½	19½	0	39	
		1960	3	0	0	22	1	0	23	Grass species moving into openings
C4	T1	1959	21½	7	0	26	23	0	49	
		1960	23	0	0	31	6	0	37	Good vigor on desirables
	T2	1959	14½	4	0	16½	20½	2	49	
		1960	11	0	0	16	7	0	23	Grasses filling in

C. Forage Production

Forage production change in Metzel Creek of the West Fork project is considerable. Metzel Creek was sprayed with fixed-wing in 1958 at high elevations (100 feet to 300 feet) and resprayed by helicopter in 1959. Twenty .96 square-foot plots were clipped in each plot in 1958 and again in 1960. Tabulated results are:

Plot	Class of forage	Pounds per acre 1958	1960	Difference
1	Forbs	885	285	-600
1	Grass	335	1,785	+1,450
2	Forbs	1,070	150	-920
2	Grass	410	1,000	+590
3	Forbs	480	150	-330
3	Grasses	190	1,800	+1,610

Clippings were dried indoors for 22 days before weighing.

X. COORDINATION

Wildlife

Some big game and sage grouse use occurs primarily during the summer on the areas treated. The control of sagebrush and wyethia was considered unimportant to the welfare of wildlife in this area.

An effort was made to avoid willow bottoms and aspen areas. However, this was not successful, as spray drifted into stream bottoms and damaged willows, which are important moose habitat. Some 12 miles of willow along the narrow stream bottoms were affected. Appraisal of this damaged area showed 80 percent of the willows were resprouting. A wider strip adjacent to this stronger type moose habitat must be left unsprayed to prevent this damage from reoccurring.

XI. PROTECTION AND MANAGEMENT

Most of the treated area will be given protection for 1 or 2 years, although some parts will be deferred only and then used lightly for 2 years.

The 3-step cluster data illustrates the necessity of strict grazing control after spraying wyethia infested ranges. Forbs have been sharply reduced. As a result, large portions of the area are not covered with vegetation. Grass seedlings are quite abundant, but need protection to become firmly established. Sagebrush areas will also greatly benefit through increased plant vigor and natural grass seeding.

The spraying on the Bull Creek C&H allotment of Jackson District was done as a part of a planned demonstration allotment. This allotment, in conjunction with the spraying project, was divided into five fenced pastures which can be deferred and rotated under a detailed system of management. Some fences were also constructed in West Fork to provide protection and then serve as distribution fences to improve management of the area in the future.

XII. CONCLUSIONS AND RECOMMENDATIONS

The overall kill results on this project are considered highly successful. Kill on big sagebrush is almost complete, except for small areas that were missed in the spray pattern. The kill of wyethia is not complete and is somewhat spotted. Many plants are still living but seriously deformed. It is believed many of these sick plants will die. The following two photos show (picture 1) a healthy stand of wyethia and (picture 2) treated area in sickly state.

1. Helicopter spraying to control sagebrush and wyethia is adaptable to Region 1 conditions and continued use is recommended.

2. Prepare future bid contracts on a per-acre basis. Consider chemical carrier, flagging, and the hauling of spray materials from a mother tanker to the helispots as part of bid.

3. Reduce chemical to 1-1/2 pounds acid equivalent and apply mixture at 2 gallon rate per acre on sagebrush areas. Continue using 2 pound acid equivalent at 3 gallon rate per acre on wyethia areas.

4. Inaccessibility and high elevations are a prime factor in keeping costs up. It is the opinion of the writers that future costs for this type of spraying can be reduced to approximately $4 per acre through use of less spray material and per acre bidding.

5. Use tankers equipped with power pumps to haul spray to helispots, whenever suitable roads exist.

6. Leave wider strip unsprayed, next to willow bottoms. Fully coordinate tentative program with local wildlife biologists and Fish & Game Departments during the planning stage and at time of application.

7. Secure written protection agreements and complete spray plans early in the year for all proposed projects.

Appendix A

BEAVERHEAD HELICOPTER SAGEBRUSH SPRAY OPERATION SAFETY PLAN

A. Refueling Helicopter at Heliports

1. Helicopter engine will be shut off.
2. Helicopter and gasoline containers will be grounded.
3. NO SMOKING within 50 feet.
4. NO SMOKING signs will be posted.
5. 15-pound fire extinguisher will be on hand.
6. Keep unauthorized personnel and spectators 100 feet away.

B. Chemical Resupply at Heliports

1. NO SMOKING signs posted.
2. NO SMOKING within 50 feet.
3. Only those personnel loading will approach helicopter, and only on signal from pilot, AND ONLY FROM THE FRONT. Others remain at least 100 feet away.

C. General

1. Fire extinguisher will be available at central storage yard and on tankers.
2. NO SMOKING signs will be posted at central storage yard - 50 feet limit.
3. First aid kits will be available at camp, central storage yard and at loading areas.
4. Stretcher will be kept in camp.
5. Radio contact will be maintained between camp and heliports and with Lima Ranger Station, if possible.
6. Pilot will rest at least 1 hour for each 4 flown, and will not fly more than 6 hours in 1 day.
7. Pilot shall be briefed on terrain and obstacles for each area flown.
8. Heliport will be free of debris.
9. Goggles will be worn by ground crew when project boss deems advisable.

/s/ Donald W. Nelson

Appendix B

SPRAY PROJECT ORGANIZATION SHEET